

Monsanto Company and KWS SAAT AG Supplemental Request for Partial Deregulation of Sugar Beet Genetically Engineered to be Tolerant to the Herbicide Glyphosate

Final Environmental Assessment

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Summary

APHIS has received a supplemental request from Monsanto/KWS to amend the petition for non-regulated status submitted in 2003 (Petition 03-323-01) pursuant to the regulatory scheme of 7 CFR Part 340. On October 8, 2010, APHIS published a notice¹ in the Federal Register (75 FR 62365-62366, Docket No. APHIS-2010-0047) announcing receipt of a supplemental Petition from the Monsanto Company (Monsanto) and KWS SAAT AG (KWS) requesting “Partial Deregulation” or some similar administrative action under 7 CFR Part 340 for sugar beets (*Beta vulgaris* ssp. *vulgaris*) designated as event H7-1 to authorize its continued cultivation subject to carefully tailored interim measures and conditions. The safeguarding measures set forth in the supplemental request were similar to interim measures that APHIS proposed to United States District Court during the remedies phase of the litigation challenging full deregulation of H7-1 sugar beet. The supplemental Petition is for a Partial Deregulation; it does not request a Full Deregulation of H7-1 sugar beet. Any decision on Full Deregulation of H7-1 sugar beet will not and cannot be made until an EIS is completed in reference to a request for a Full Deregulation of H7-1 sugar beet.

The supplemental petition is related to a petition submitted by Monsanto and KWS on November 19, 2003, seeking a determination of nonregulated status for event H7-1 sugar beets (Petition 03-323-01). On October 19, 2004, APHIS published a notice in the *Federal Register* (69 FR 61466-61467, Docket No. 04-075-1) announcing that the Monsanto/KWS petition and an EA were available for public review. On March 17, 2005, APHIS published a notice in the Federal Register (70 FR 13007-13008, Docket No. 04-075-2) advising the public of its Determination Decision, effective March 4, 2005, that event H7-1 sugar beets posed no plant pest risk and

¹ To review the notice and the supplemental petition, go to

<http://www.regulations.gov/fdmspublic/component/main?main=DocketDetail&d=APHIS-2010-0047>.

should no longer be considered a regulated article under APHIS regulations codified at 7 CFR Part 340. Pursuant to this regulatory Determination Decision, H7-1 sugar beet seed and root crops were fully deregulated and could be grown without any APHIS imposed conditions. On September 21, 2009, the US District Court for the Northern District of California (Court) found that APHIS should have prepared an environmental impact statement (EIS) before making a decision on whether or not to grant nonregulated status to event H7-1 (*Center for Food Safety et al. vs. Thomas Vilsack et al.*). On August 13, 2010, the Court vacated APHIS's decision to fully deregulate event H7-1 sugar beet varieties, making them subject to the Plant Protection Act of 2000 (PPA) and 7 CFR Part 340 once again, and remanded the matter back to the agency to determine regulatory actions, if any, that should be imposed upon event H7-1 sugar beets in the interim until the completion of the EIS and a new Determination Decision could be made by APHIS as to whether it would be appropriate to grant full nonregulated status to event H7-1. The EA analyzes the alternatives available to APHIS for its decision regarding this supplemental request for partial deregulation or for similar administrative action to authorize the cultivation of event H7-1 sugar beets subject to carefully tailored interim measures proposed by APHIS.

Based on the scope of the EA, the specific decisions to be made are:

- Should APHIS grant the supplemental Monsanto/KWS Petition request for “partial deregulation” or similar administrative action to authorize the continued cultivation of event H7-1 sugar beets subject to the interim measures proposed by APHIS to the Court?
- Should APHIS continue to regulate the release into the environment and movement of event H7-1 sugar beets (both all root and seed production activities) under 7 CFR Part 340?
- What conditions (interim regulatory measures) should be imposed to prevent any potential plant pest risk from planted event H7-1 sugar beets that are partially deregulated and thus removed from Part 340 regulation, to minimize disruptions to U.S. sugar beet production, and to minimize the likelihood of impacts noted by the Court until APHIS can complete an EIS before making a determination decision on whether or not to grant Full nonregulated status to event H7-1 sugar beets?

- Would the preferred alternative, if selected, have significant impacts on the quality of the human environment requiring preparation of an EIS?

The EA has been prepared to analyze the alternatives available to APHIS for responding to this supplemental request and to provide the public with documentation of APHIS' review and analysis of any potential individual and cumulative environmental impacts associated with the partial deregulation or for similar administrative action to authorize the cultivation of event H7-1 sugar beets subject to carefully tailored interim measures proposed by APHIS.

The EA considers and evaluates four reasonable alternatives. The alternatives analyzed in the EA include:

- Alternative 1 - APHIS Denies Petition Request for Partial Deregulation/ No Further Actions to Authorize Cultivation of Event H7-1 Sugar Beets (No Action). This alternative would deny the request for partial deregulation or any similar administrative action under 7 CFR Part 340 for the cultivation of event H7-1 sugar beets, thereby halting any consideration of authorizing commercial production until the completion of the EIS.
- Alternative 2 - Event H7-1 Sugar Beet Production (Seed/Root) Regulated Under 7 CFR Part 340. This alternative would authorize the commercial production of event H7-1 sugar beets under APHIS permits, in accordance with 7 CFR Part 340, subject to mandatory conditions to prevent any potential plant pest risks from such cultivation. These conditions are intended both to minimize any potential for the escape and dissemination of plant pests and the likelihood of impacts of concern raised by the Court in the lawsuit challenging APHIS' decision to deregulate event H7-1 sugar beets.
- Alternative 3 - Partial Deregulation of Event H7-1 Sugar Beets (Seed/Root). This alternative would grant the petition request for partial deregulation to allow the commercial production of event H7-1 sugar beets. The supplemental request that APHIS received from Monsanto/KWS did not clearly explain what the petitioners mean or envisioned by a "partial deregulation." The petitioner did not identify any specific mechanism(s) that would be used to impose the conditions to prevent any potential plant

pest risks, which parties would be subject to the conditions, or how compliance with the conditions would be ensured. APHIS has interpreted this petition to mean that Monsanto/KWS is requesting that event H7-1 sugar beets would no longer be regulated under 7 CFR Part 340 provided that they are cultivated under the conditions and interim measures that APHIS proposed to the Court. APHIS further interprets the request to mean that Monsanto/KWS would be the responsible party for overseeing implementation and monitoring of conditions for cultivation of event H7-1 sugar beets. Under this alternative, APHIS would grant the petition for partial deregulation; APHIS would no longer regulate event H7-1 sugar beets under 7 CFR Part 340; and the cultivation of event H7-1 sugar beets would be allowed under conditions imposed by Monsanto/KWS through technology stewardship agreements, contracts, or other legal instruments.

- Preferred Alternative – Partial Deregulation – Combination of Alternatives 2 and 3.

APHIS has determined that it is appropriate to partially deregulate H7-1 sugar beets by combining aspects of Alternative 2 in regards to seed production activities and a modification of Alternative 3 in regards to root production activities. Under this partial deregulation alternative, APHIS would *deny* the supplemental request for partial deregulation with regard to H7-1 sugar beet seed production activities meaning that seed production activities would remain regulated pursuant to 7 CFR Part 340. However, pursuant to and in compliance with 7 CFR 340.6, APHIS would grant the supplemental request with regard to H7-1 root production activities and partially deregulate those activities as long as certain specific mandatory conditions are complied with by anyone desiring to conduct H7-1 sugar beet root production activities. APHIS has evaluated the supplemental petition and has concluded that H7-1 sugar beet root production activities, when conducted under specific mandatory conditions required and enforced by APHIS, are unlikely to pose a plant pest risk (USDA-APHIS 2011). Therefore, APHIS has determined that H7-1 sugar beet root production activities carried out under this interim action, if conducted under these mandatory conditions, should no longer be subject to the procedural and substantive requirements of 7 CFR Part 340. If, however, commercial

root production activities are not conducted pursuant to these mandatory conditions, the APHIS Administrator has the regulatory authority and discretion to return such root production activities to regulation under 7 CFR Part 340.

These mandatory conditions under the Preferred Alternative would be imposed and enforced pursuant to written APHIS compliance agreements authorized under the PPA. Similar to a permit, the compliance agreements would be used to authorize the movement and release into the environment of H7-1 root crop and would impose certain mandatory conditions on the movement and environmental release of the H7-1 sugar beet root crop and root production activities. These legally binding and enforceable compliance agreements would specify the mandatory conditions for partial deregulation of the root production activities and would formalize and impose the mandatory conditions under which the root crop and root production activities would be considered partially deregulated; i.e., no longer subject to the procedural and substantive requirements of the Part 340 regulation. APHIS would employ these required compliance agreements to authorize movement and release of H7-1 sugar beets and to impose and enforce the mandatory conditions on the import, movement or environmental release of the root crop and root production activities and the compliance agreements would be a formal, written, and signed agreement between APHIS and a person who wants to import, move, and/or do an environmental release in conjunction with the H7-1 sugar beet root crop production activities [note that movement and the environmental release includes the entire production cycle of H7-1 sugar beet root crop – referred to collectively as all the “root production activities”; and the terms person, import, or move have the meanings as they are so defined in the Plant Protection Act (PPA), as amended]. For the environmental release of H7-1 sugar beets associated with the root crop production activities, required information for the compliance agreement will include: identifying the responsible party, contact information, location of the environmental release(s), and total number of acres to be planted. For the movement and/or importation of H7-1 sugar beets associated with the root crop production activities, required information for the compliance agreement

includes: identifying the responsible party, contact information, and point of origin and final destination(s).

Under the Preferred Alternative, the compliance agreements would be enforced under the authority of the PPA and 7 CFR Part 340. If APHIS determines that any of the mandatory conditions of the partial deregulation set forth in the compliance agreements are not complied with, APHIS may revoke, withdraw or otherwise cancel the conditional partial deregulation for the commercial root crop production activities. Further, APHIS may use the full range of PPA authorities to seek, as appropriate and necessary, criminal and/or civil penalties, and to take remedial measures including seizure, quarantine, and /or destruction of any root crop or root production activity in violation of the mandatory conditions of the partial deregulation. APHIS inspections and/or third party inspections/audits will be required to ensure that persons importing, moving, and/or doing an environmental release (planting) in conjunction with the H7-1 sugar beet root crop comply with all conditions and restrictions identified in the compliance agreements.

Actions taken by APHIS under this Preferred Alternative would be interim in nature, meaning that they will be limited in scope and duration, and would neither result in significant impacts to the human environment nor prejudice any future decision to be analyzed in the forthcoming EIS for a determination decision in response to a petition for a full deregulation of H7-1 sugar beets. APHIS is aiming to complete the EIS by May 28, 2012, but unforeseen conditions may affect the specific completion date. This interim, conditional, and partial deregulation of the H7-1 sugar beet root crop and root production activities along with the interim Part 340 permitting of the H7-1 seed crop, which would not be partially deregulated, will remain in effect through December 31, 2012, to allow the harvesting and processing of the 2012 commercial root crop and seed crop unless APHIS issues a Final EIS, Record of Decision, and Determination decision for a Full Deregulation of H7-1 sugar beets before those harvest are completed in 2012. If APHIS makes a determination decision, after completion of the EIS, to fully deregulate

H7-1 sugar beet, the Record of Decision for that EIS for full deregulation will supersede and replace this partial deregulation FONSI, if it occurs prior to termination date of the interim action, which is December 31, 2012.

Moreover, the actions taken by APHIS under this Preferred Alternative are not new or novel. APHIS has a long history of issuing permits under its part 340 regulations and also of entering into compliance agreements similar to the ones that will be required under the Preferred Alternative. Compliance agreements are well established in APHIS as an effective and efficient compliance mechanism to authorize and allow activities governed by the PPA and maintain oversight and compliance with ~~of~~ those authorized activities. Additionally, the Preferred Alternative is similar to other APHIS actions that do not normally require the preparation of an EIS. Similar to the permits issued under 7 CFR Part 340, including the permits that will be issued for this interim action allowing seed crop production activities, the compliance agreements used for the conditional Partial Deregulation of root crop production activities will require responsible parties (for example, the root crop cooperatives and processors) to submit field location and acreage information to APHIS and to be subject to inspections and audits. The compliance agreements are legally binding and enforceable agreements between APHIS and entities involved in H7-1 sugar beets root crop production activities. The APHIS Administrator may, in her discretion, revoke, withdraw, or otherwise cancel the conditional partial deregulation for commercial root crop production activities when it is appropriate to do so because of noncompliance or other violation of the mandatory conditions of the Partial Deregulation. Further, APHIS may use the full range of its PPA authorities to seek, as appropriate and necessary, criminal and/or civil penalties, and to take appropriate remedial measures including seizure, quarantine, and /or destruction of any root crop or root crop production activity that is in noncompliance or other violation of the mandatory conditions of the Partial Deregulation. Moreover, as stated below, APHIS has previously examined the potential impacts of deregulating H7-1 sugar beets in conjunction with its decision in response to an original 2003 Petition for nonregulated status and then an

updated 2004 Petition. Based on this vast experience, the impacts that can be expected from implementing the Preferred Alternative are well understood and thoroughly evaluated in this EA.

Alternatives considered but rejected in the EA include: (1) Deregulating root production under conditions imposed by APHIS while prohibiting seed production, (2) deregulating seed production under conditions imposed by APHIS while prohibiting root production, and (3) deregulating seed production under conditions imposed by APHIS while authorizing continued root production under APHIS permits or notification.

APHIS in compliance with all CEQ Regulations provides this environmental assessment as part of the decision-making process to address the supplemental request for partial deregulation of sugar beets genetically engineered (GE) for tolerance to the herbicide glyphosate, or for similar administrative action to authorize continued cultivation of the GE sugar beets subject to conditions proposed by APHIS. The EA was available for public comment for 30 days. Comments received by the end of the 30-day period were analyzed and used to inform APHIS' decision on whether to grant the supplemental request for partial deregulation of the GE sugar beets or to grant some similar administrative action to authorize the continued cultivation of the GE sugar beets.

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growers to observe specific precautions including buffer zones when spraying glyphosate herbicides on glyphosate-tolerant crops near threatened and endangered plant species that may be at risk. In addition, label requirements for Monsanto's Roundup® formulations and glyphosate formulations marketed by other manufacturers prohibit application in conditions or locations where adverse impact on federally designated endangered/threatened plants or aquatic species is likely.

In conclusion, there are legal precautions in place (EPA label use restrictions) and "best practice" guidance to reduce the possibility of exposure and adverse impacts to TES from glyphosate application to H7-1 sugar beet; EPA has considered potential impacts to TES as part of their registration and labeling process for glyphosate; and adherence to EPA label use restrictions by the pesticide applicator will ensure that the use of glyphosate will not adversely affect TES or critical habitat. Based on these factors and the legal requirements for pesticide applicators to follow EPA label use restrictions, APHIS has determined that the use of EPA registered glyphosate for H7-1 sugar beet production will not adversely impact listed species or species proposed for listing and would not adversely impact designated critical habitat or habitat proposed for designation.

H. Cumulative Impacts

Cumulative impacts, as defined by CEQ (40 CFR 1508.7), are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time.

This section discusses the cumulative impacts that are associated with the preferred alternative, when combined with other recent past, present, and reasonably foreseeable future actions within the affected environment. APHIS has published a Notice of Intent in the *Federal Register* announcing its intent to prepare an EIS in association with the petitioner's request to deregulate H7-1 sugar beets. However, APHIS' decision to produce an EIS and this interim EA by no means is an indication of when or if APHIS will or will not decide to deregulate H7-1 sugar beet. APHIS will not make a determination on whether or not to grant nonregulated status to H7-1

sugar beet until a final EIS and PPRA are completed. Therefore the potential impacts of fully deregulating H7-1 sugar beets will not be included in this cumulative impacts analysis.

Cumulative impacts occur when the effects of an action are added to the effects of other actions occurring in a specific geographic area and timeframe. The cumulative impact analysis follows CEQ's guidance: Considering Cumulative Effects under the National Environmental Policy Act (CEQ, 1997). The steps associated with the analysis include:

- Specify the class of actions for which effects are to be analyzed.
- Designate the appropriate time and space domain in which the relevant actions occur.
- Identify and characterize the set of receptors to be assessed.
- Determine the magnitude of effects on the receptors and whether those effects are accumulating.

Class of Actions to be Analyzed

This analysis addresses large, regional and national-scale trends and issues that have impacts that may accumulate with those of the proposed conditions.

a. Geographic and Temporal Boundaries for the Analysis

As described in the Affected Environment, over the past 10 years, the number of acres planted annually in sugar beets in the US has ranged from 1.1 to 1.4 million (USDA NASS 2010c). H7-1 sugar beets are produced in five major regions in the US (see Figure 5). Commercial production of sugar beet seeds takes place primarily in the Willamette Valley of Oregon (see Figure 5), with some minor production in Madras, Medford, and Grants Pass, Oregon (Greg Loberg, personal communication to Bill Doley, Sept. 2, 2010) and in south-central Washington in the Columbia River Basin, and small acreage production of stecklings occurs in Oregon, Arizona, and Washington (personal comm., Bill Doley). Therefore, the spatial domain for past, present, and reasonably foreseeable future actions considers these areas for issues associated with growing H7-1 sugar beets and the nation, and in some cases international areas, for issues associated with consumption of sugar beet food and feed products and for socioeconomic impacts. This analysis focuses more on geographic interaction of projects than timing of

interactions because the actual timeframes for many of the reasonably foreseeable future actions are not definitively known. APHIS considers reasonably foreseeable actions as those future actions for which there is a reasonable expectation that the action could occur, such as the preferred alternative under analysis, a project that has already started, or a future action that has obligated funding. Thus harvesting of H7-1 sugar beet roots, stecklings and seeds that were planted prior to the decision on the lawsuit and planting of stecklings under permits that APHIS has issued, are actions that either have occurred, will occur or are reasonably certain to occur. It also includes other actions such as crop rotations and associated weed and land management practices that overlap in space and time with areas that are likely to grow H7-1 derived sugar beet varieties.

APHIS has identified activities relevant to the cumulative impacts analysis from reviews of information available from government agencies, such as environmental impact statements, land-use and natural resource management plans, and from private organizations. Not all actions identified in this analysis would have cumulative impacts on all resource areas.

Resources Analyzed

Issues evaluated in this cumulative impacts analysis are associated with the resource areas discussed in the Affected Environment and Environmental Consequences sections. Specific topics analyzed include: cumulative impacts related to any possibility of development of herbicide resistant weeds, and cumulative impacts related to changes in tillage and herbicide usage, including potential increased glyphosate usage with the cultivation of glyphosate tolerant crops.

a. Magnitude of Effects on Resources

The potential extent of the impacts of the preferred alternative combined with other actions, and the duration of those impacts are considered in determining the magnitude of cumulative effects that impact each resource area. When possible, the assessment of the effects on a resource is based on quantitative analysis, however, many effects are difficult to quantify. In these cases, a qualitative assessment of cumulative impacts is made. Incomplete or unavailable information is documented in accordance with 40 CFR § 1502.22 .

As suggested by the CEQ (1997) handbook, *Considering Cumulative Effects under the National Environmental Policy Act*, this EIS considered the following basic types of cumulative effects that might occur due to the preferred alternative:

- *Additive*—loss of a resource from more than one incident.
- *Countervailing*—adverse effects are compensated by beneficial effects.
- *Synergistic*—total effect is greater than the sum of effects when considered independently.

In the following analysis, cumulative impacts should be considered additive unless designated as otherwise. In the case of most resources that may experience cumulative impacts, the preferred alternative is only responsible for a contribution of an incremental portion the total impact on the resource. The past, present, and reasonably foreseeable connected actions typically contribute to the majority of impacts experienced by the resource, and would continue to have impacts on the resource even if the no action alternative were implemented.

Analysis of Cumulative Impacts by Resource Area

a. Biological Resources

Beta Crops. As discussed in the Environmental Consequences section, no or negligible effects are expected from the cultivation of H7-1 sugar beet derived varieties under the preferred alternative with respect to all conventional or organic *Beta* crops based on the following conclusions: (1) In most cases no gene flow from H7-1 lines to other *Beta* crops is expected and if it does occur is not expected to exceed detectable levels of 1 seed in 10,000. Inconsequential admixture will have little impact on grower sales of organic products to many buyers (neither

Federal regulations nor major commercial standards prohibit such sales). Hence no or negligible impacts from gene flow from H7-1 sugar beet root or seed crops to conventional Beta seed or root crops would be expected; (2) The availability of vegetable beet seeds with no detectable H7-1 trait, together with the fact that gene flow cannot occur during vegetable production means that there will be no negative impacts to organic vegetable beet production; (3) The permit conditions will prevent seed mixing (permit condition 4), which makes current seed and steckling production and handling practices mandatory (described in the Affected Environment section), is expected to eliminate any admixture of H7-1 in conventional sugar beet and vegetable crop seeds. Hence no impacts are expected resulting from mechanical mixing of harvested beets of H7-1 and conventional sugar beet and vegetable crop seeds; (4) There is currently no commercial organic sugar beet production in the US, and the preferred alternative is not expected to result in impacts to organic growers who may choose to grow sugar beets in the future. Therefore the preferred alternative would have no cumulative impact on conventional or organic sugar beet root crops.

Herbicide Resistant Weeds and Glyphosate. Glyphosate offers many benefits to the grower as a weed control product. Glyphosate controls a broad spectrum of grass and broadleaf weed species present in sugar beet root production fields and sugar beet seed and steckling production fields, has flexible use timings, and when used in glyphosate-tolerant crops, has a very high level of crop safety (see petition 03-323-01p, Tables VII-4 and VII-5, pages 90 and 92, respectively). As the adoption of glyphosate-resistant crops has grown, the use of glyphosate has increased over the past several years. Crops that contain the same modified EPSPS protein as H7-1 sugar beet have been granted non-regulated status and have included corn, soybean, cotton and rapeseed (http://www.aphis.usda.gov/brs/not_reg.html). In 2004, significant acreages of corn (10.3 million acres or 11% of the total), upland cotton (4.1 million acres or 30% of the total) and soybean (62.6 million acres or 85% of the total) grown in the U.S. were planted with herbicide tolerant varieties (<http://usda.mannlib.cornell.edu/>). With the increased use of glyphosate, there is also the potential for increased selection pressure for the development of glyphosate-resistant weeds.

Shifts to more inherently herbicide tolerant weed species and evolution of herbicide resistant biotypes of species that are normally susceptible to a given herbicide under normal use rates are

not unique to glyphosate resistant crop systems (Heap, 2010). These shifts are influenced by the intensity of the selection pressure by the herbicide mode of action, the mechanisms of resistance, and diversity in the cropping system including herbicide mode of action and other weed control and cultivation practices. The Affected Environment section provides information about the major sugar beet weeds and occurrence of resistance to those herbicide groups used in sugar beet production (Table 7). In this cumulative impacts section, APHIS considered the likelihood that herbicide tolerant or resistant weeds would develop in sugar beet seed and root production systems and produce cumulative impacts in rotational or nearby cropping systems.

Sugar Beet Seed Production. Herbicides with several different modes of action are available for control of the major weeds in sugar beets in the Pacific Northwest (Oregon, Washington, and Idaho) (Morishita, 2009). The weed control program for sugar beet seed and steckling production is essentially the same as for sugar beet root crops with some exceptions, i.e. glyphosate is not generally used post-emergent in seed production except for sometimes the glyphosate resistant parent is sprayed if the other non-resistant parent is not present (Greg Loberg, personal communication to Bill Doley, Sept. 2, 2010; Kockelmann and Meyer, 2006). Major sugar beet weeds that have developed resistance to herbicide modes of action that are used in sugar beets and that occur in Oregon and/or Washington include:

- Wild oat (*Avena fatua*) with resistance to ACCase inhibitors and/or mitosis inhibitors infesting wheat;
- Kochia (*Kochia scoparia*) and spiny sowthistle (*Sonchus asper*) with resistance to ALS inhibitors, infesting wheat and/or cereals;
- Redroot pigweed (*Amaranthus retroflexus*) and Powell amaranth (*Amaranthus powellii*) with resistance to photosynthesis II (PSII) inhibitors infesting mint (Heap, 2010).

No major sugar beet weeds with resistance to glyphosate have been confirmed by the International Survey of Herbicide Resistant Weeds in Oregon or Washington (Heap 2010). The International Survey of Herbicide Resistant Weeds (Heap, 2010) also does not identify any herbicide resistant weeds in Arizona.

The Willamette Valley is used for seed production for many different kinds of seeds. In addition to seeds, many vegetables are also commercially grown in the valley. It is a major area for

production of “most temperate vegetables, herbs and vegetable seeds” (Mansour, 1999). Rotation crops for seed and steckling production are highly variable, but often include a grass or a grain (e.g. wheat) (Greg Loberg, personal communication to Bill Doley, Sept. 2, 2010). Preceding crops feature those that are harvested early enough to allow plowing and field preparation before sugar beet seed planting or before transplanting of stecklings (typically cereals, wheat or vegetable crops). As noted in the Biological Resources Section of the Affected Environment, a minimum of five years of rotation with non *Beta* crops are required for seed production fields, however there are no rotation restrictions or requirements for steckling nurseries because no seed is produced and there is less concern with root diseases. Field herbicide history is also a factor taken into consideration.

Because a glyphosate-based herbicide program is currently being used with H7-1 sugar beet seed and steckling production, glyphosate use for H7-1 is not expected to increase beyond current levels, as market penetration is already at 95%. Since no major sugar beet weeds with resistance to glyphosate occur in Oregon, Washington or Arizona, it is anticipated that they are unlikely to be selected under the preferred alternative due to several factors: 1) glyphosate use would not be expected to increase beyond its current use as a pre-emergent or pre-transplant application in fields where conventional non-glyphosate resistant sugar beet seed or stecklings are being grown or as a post-emergent application in a limited number of fields which contain ONLY glyphosate tolerant parents or stecklings; 2) herbicides with other modes of action can be used after emergence or transplanting and later before canopy closure; and 3) other typical cultural practices can reduce weed populations or reduce the likelihood that mature seed will be set, e.g. mechanical tillage, roguing and swathing of the sugar beet seed. Major weeds of sugar beet may continue to be selected for resistance to other herbicides commonly used in sugar beets in these seed production areas (Morishita, 2009). Selection could also continue for those weeds that have already developed herbicide resistance. The major weeds of sugar beet which have already developed resistance to herbicides that are also commonly used in sugar beet are reported as infesting crops other than sugar beet (i.e. wheat, cereals, and/or mint as indicated above) (Heap 2010). Therefore it is unlikely that past weed control practices in sugar beet have significantly contributed to the development of herbicide resistance in these weed biotypes, and is therefore unlikely to occur as a result of actions occurring under the preferred alternative . At least three alternative herbicides with other modes of action to which these weeds have not developed

resistance can provide at least fair control of these major weed species in sugar beet (Morishita 2009). Examples for each resistant weed and the herbicides effective at controlling it include:

- Wild oat: Fatty acid and lipid biosynthesis inhibitor herbicides EPTC, cycloate, and ethofumesate.
- Kochia: EPTC, ethofumesate; and mitosis inhibitor herbicides trifluralin and dimethenamide-P,
- Sowthistle: EPTC, ethofumesate, clopyralid, and dimethenamide-P
- Pigweeds: [redroot pigweed (*Amaranthus retroflexus*) and Powell amaranth]: EPTC, cycloate, and ethofumesate, trifluralin and dimethenamide-P, and triflurosulfuron.

The limited use of glyphosate as a post-emergent herbicide to control weeds only around glyphosate tolerant plants in seed production or steckling fields would continue to allow for an additional post-emergent weed control option for herbicide resistant wild oats, kochia, and pigweeds (Table 4). Glyphosate can provide fair to excellent control of these weeds as well as eight other major weeds in sugar beets.

In summary, significant cumulative impacts with respect to increased resistance to herbicides are not anticipated for sugar beet seed and steckling production areas given the relatively low acreage planted to sugar beet seed and stecklings; the rotation cycle for sugar beet seed production; the diversity of rotation crop options and weed control options; the lack of sugar beet weeds with resistance to glyphosate in sugar beet seed and steckling production areas; and the ability of glyphosate to provide an extra post-emergent control option for sugar beet weeds that have already developed resistance to some other herbicides used in sugar beets.

In addition, sugar beet itself is not considered a significant weed, and furthermore, the permit conditions proposed for the control of volunteers of H7-1 in seed production fields should prevent it from becoming a weed problem in rotation crops.

Sugar Beet Root Production. APHIS examined herbicides available for the control of major sugar beet weeds in states in the five regions where sugar beet root production occurs, the occurrence of weed biotypes resistant to those herbicides, the availability of alternative options

to control those weeds, and the impact that resistant weeds would have on regional agriculture and rotation crops, including those that are resistant to glyphosate.

Table 3 in the Biological Resources section of the Affected Environment in this EA shows herbicide applications to sugar beet acres in the US in 2000, prior to the commercial cultivation of glyphosate resistant H7-1, in terms of the herbicide, its trade name, the WSSA mode of action group for the herbicide, the percentage of acres treated, applications per year, the rate per application and the total applied per year. Thirteen different herbicides, including glyphosate, are included representing 8 different WSSA modes of action groups. From this data, the most commonly used herbicide in terms of either percentage of acres treated (> 45 %) or number of applications/year (>2.0) are listed below along with their mode of action:

- Desmedipham (94%, 2.8 application/yr) – Grp. 5 - photosynthesis inhibitor
- Triflurosulfuronmethyl (83%, 2.7 applic./yr) – Grp. 2- ALS inhibitor,
- Phenmedipham (80%, 2.6 applic./yr) – Grp. 5 – photosynthesis inhibitor
- Clopyralid (74%, 2.8 applic./yr) – Grp. 4 – synthetic auxin
- Clethodim (46%, 2.5 applic./yr) – Grp. 1- ACCase inhibitor.

Table 7 in the Biological Resources section of the Affected Environment shows the major sugar beet weeds with resistance to herbicide groups used in sugar beets as obtained from the International Survey of Herbicide Resistant Weeds (Heap, 2010), organized by states in which sugar beets are grown commercially. Biotypes of seventeen weeds with confirmed resistance to one or more herbicides are noted. Weed biotypes with resistance to ALS inhibitor herbicides, PSII inhibitor herbicides and ACCase inhibitor herbicides are the most prevalent in terms of the number of weed biotypes and states with reported resistance. This trend follows the trend in herbicide resistant weed biotypes worldwide as herbicides in these classes have the highest number of resistant weed biotypes (Figure 3).

With the exception of the synthetic auxin herbicides, the trend in resistant weed biotypes by mode of action also follows the overall herbicide use pattern for sugar beets, the vast majority of which is for root production. However, this does not necessarily mean that cultivation of conventional or glyphosate-resistant sugar beets has led to the development of these resistant

biotypes in these states. Many of these major weeds in sugar beet that have developed herbicide resistance are also considered weeds in other crops which are planted to much larger acreages . Resistance may have developed in these other crop situations or the resistant weeds may have been transported to these situations from contaminated seed, field equipment or by other means from other areas. Because sugar beet yield and/or quality are usually higher when sugar beets follow barley or wheat in the crop rotation compared to corn, potatoes, soybean, edible dry beans, or summer fallow (Cattanach et al., 1991), resistant weeds in these crops may be more likely to impact sugar beets. Based on information in the International Survey of Herbicide Resistant Weeds (Heap, 2010) for situations in which the resistant weeds are reported to infest, very few of the resistant weed biotypes are specifically reported as infesting sugar beet (or general cropland which could possibly include sugar beet), however several occur in crops that are grown in rotation with sugar beet (See Tables 16 and 17). Table 4 summarizes the effectiveness of herbicides on major weeds in sugar beets as provided by three sources. The Table 16 also includes an analysis of information from Table 4 as to whether glyphosate and/or an alternative herbicide with a mode of action different from the reported resistance is rated as providing fair to excellent control of the resistant weed species in either a pre-plant incorporated, pre-emergent, or post-emergent application.

Table 16. Major sugar beet weeds with resistance to herbicide groups

Weed Common Name	Herbicide Mode of Action	States Reported & Year Reported or Confirmed	Crops infested, estimated number of sites and acres. (+ indicates that either the # sites or acres is increasing)	Effective control option with glyphosate and/or alternative non-resistant herbicide.
Barnyardgrass	ACCase Inhibitor & Fatty acid synthesis inhibitor	CA 2000	Rice-11-50 sites, 101-500 A+	Glyphosate/Post-E
Kochia	PSII inhibitor	CO 1982, WY, MT 1984, ND 1998	CO-Corn, 501-1000 sites, 1001-10,000 A+; WY-Corn, 11-50 sites, 1001-10,000 A stable; MT-railways, 6-10 sites, 501-1000 A+, ND-Corn, 1 site, 11-50 A.	Glyphosate/Pre-E, Post-E
	ALS inhibitor	ND 1987, WA, MT, CO, ID 1989, OR 1993, MN	ND-Cropland & wheat, 501-1000 sites, 1-2 million A+; WA-Cereals & wheat,	Glyphosate/Pre-E, Post-E,

Weed Common Name	Herbicide Mode of Action	States Reported & Year Reported or Confirmed	Crops infested, estimated number of sites and acres. (+ indicates that either the # sites or acres is increasing)	Effective control option with glyphosate and/or alternative non-resistant herbicide.
		1994, WY 1996, MI 2005	501-1000 sites, 1001-10,000 A+; MT-Cropland & wheat, 1001-10,000 sites, 0.10-1.0 million A+; CO-Roadsides & wheat, 501-1000 sites, 10,001-100,000 A+; ID- Roadsides & wheat, 501-1000 sites, 10,001-100,000 A+; OR-Wheat, 51-100 sites, 1001-10,000 A+; MN-Cropland & wheat, 11-50 sites, 1001-10,000 A +; WY-Wheat, 2-5 sites, 501-1000 A+; MI-Sugar beet, 2-5 sites, 101-500 A+	
	Synthetic auxin	ND, MT 1995, ID 1997	ND-Wheat, 6-10 sites, 101-500 A+; MT-Cropland & wheat, 101-500 sites, 1001-10,000 A+; ID-Roadsides, 1 site, 1-5 A+.	Glyphosate/Pre-E, Post-E,
Wild oat	ACCase inhibitor	MT 1990 & 2002; OR 1990; WA, MN, ND 1991; ID 1992; CO 1997	MT-Cropland, sugar beet and wheat. 51-100 sites, 1001-10,000 A+ OR-Wheat, 101-500 sites, 1001-10,000 A+; WA- Wheat, 51-100 sites, 10,000 A+; MN- Sugar beet & wheat. 51-100 sites, 1001-10,000 A+.; ND-Cereals & wheat. 101-500 sites, 1001-10,000A+ ID - Cereals & wheat. 11-50 sites, 1001-10,000A+ CO- Barley & wheat. 6-10 sites, 101-500 A+	Glyphosate/PPI, Pre-E, Post-E
	Fatty acid synthesis inhibitor	MT 1990, ID 1993	MT-Barley. 501-1000 sites, 10,001-100,000A+; ID-Cereals. 51-100 sites, 10,001-100,000A+	Glyphosate/Post-E
	ALS inhibitor	MT &	MT-Cereals,. 2-5	Glyphosate/PPI, Pre-E,

Weed Common Name	Herbicide Mode of Action	States Reported & Year Reported or Confirmed	Crops infested, estimated number of sites and acres. (+ indicates that either the # sites or acres is increasing)	Effective control option with glyphosate and/or alternative non-resistant herbicide.
		ND1996,	sites, 11-50 A+; ND-Wheat. 2-5 sites, 501-1000 A+.	Post-E
	Mitosis inhibitor	OR 1990	Cropland. 1 site, 11-50 A stable.	Glyphosate/PPI, Pre-E, Post-E
Lambsquarter	PSII inhibitor	MI 1975 MN 1982	MI -Corn, nurseries, soybean. 100,000 A. MN – Corn. 101-500 sites, 501-1000 A. stable.	Glyphosate/PPI, Pre-E, Post-E
	ALS inhibitor	MI 2001	Soybean. 2-5 sites, 101-500 A+.	Glyphosate/PPI, Pre-E, Post-E
Redroot pigweed	PSII inhibitor	CO 1982, MN 1991 OR 1994 ID 2005,	CO - Corn, 501-1000 sites, 10,000 A +; MN – Corn, 1 site, 11-50 A stabilized; OR-Mint, 6-10 sites, 101-500 A+. ID- Potato, 2-5 sites, 501-1000 A.	Glyphosate/PPI, Pre-E, Post-E
	PSII inhibitor (incl. Ureas and Amides)	MI 2001	Asparagus. 6-10 sites, 51-100 A+	Glyphosate/PPI, Pre-E, Post-E
	ALS inhibitor	ND 1999	Soybean. 1 site. 1-5 A. stable.	Glyphosate/PPI, Pre-E, Post-E
Tall water hemp	ALS inhibitor	MI 2000;	Soybean. 6-10 sites, 101-500 A.	Glyphosate/PPI, Pre-E, Post-E
	Glycine	MN 2007	Soybean. 2-5 sites, 51-100 A +.	PPI, Pre-E, Post-E
	PSII inhibitor	NE 1996	Corn – NA	Glyphosate/PPI, Pre-E, Post-E
Powell Amaranth	PSII inhibitor	WA 1992;	Mint – NA	Glyphosate/PPI, Pre-E, Post-E
	PSII inhibitor, Urea and amides	MI 2001	Asparagus & nurseries. 11-50 sites, 101-500 A +.	Glyphosate/PPI, Pre-E, Post-E
Smooth pigweed	ALS inhibitor	MI 2002	Soybean. 2-5 sites, 101-500 A.	Glyphosate/PPI, Pre-E, Post-E
Velvetleaf	PSII inhibitor	MI 2004	Corn, nurseries, soybean. 2-5 sites, 101-500 A +.	Not rated
	PSII inhibitor	MN 1991	Corn. 1 site, 11-50 A. Stabilized	Not rated but not a weed in SB rotation crops in MN.
Eastern Black nightshade	PSII inhibitor	MI 2004	Blueberry. 2-5 sites, 101-500 A.	Glyphosate/PPI, Pre-E, Post-E
	ALS inhibitor	ND 1999	Soybean. 2-5 sites, 501-1000 A +	Glyphosate/PPI, Pre-E, Post-E
Giant Foxtail	ALS inhibitor	MN 1996; MI 2006	Corn & soybean. MN -1 site, 11-50 A. + MI -1 site, 101-500 A.	Glyphosate/PPI, Pre-E, Post-E
Robust White Foxtail	ALS inhibitor	MN 1996	Corn & soybean. 1 site, 11-50 A, +.	Glyphosate/PPI, Pre-E, Post-E

Weed Common Name	Herbicide Mode of Action	States Reported & Year Reported or Confirmed	Crops infested, estimated number of sites and acres. (+ indicates that either the # sites or acres is increasing)	Effective control option with glyphosate and/or alternative non-resistant herbicide.
	ACCase inhibitor	MN 1999	Soybean. 6-10 sites, 11-50 A, stabilized.	Glyphosate/PPI, Pre-E, Post-E
Purple Robust Foxtail	ACCase inhibitor	MN 1999	Soybean. 1 site, 11-50 A, stabilized.	Glyphosate/PPI, Pre-E, Post-E
Yellow Foxtail	ALS inhibitor	MN 1997	Soybean. 1 site, 1-5 A, increasing.	Glyphosate/PPI, Pre-E, Post-E
Green Foxtail	Mitosis inhibitor	ND 1989	Sunflower and wheat. 501-1000 sites, 1001-10,000 A, increasing.	Glyphosate/PPI, Pre-E, Post-E
Giant Ragweed	Glycine	MN 2006	Soybeans. 2-5 sites, 101-500 A, increasing.	/Post-E
Common Cocklebur	ALS Inhibitor	MN 1994	Soybeans. 2-5 sites, 11-50 A, increasing.	Glyphosate/Marginal Pre-E; Post-E
Spiny Sowthistle	ALS Inhibitor	WA 2000.	Lentils and wheat. 6-10 sites and acres.	/Pre-E; Post-E

Table 17: Sugar beet weed biotypes with confirmed herbicide resistance that are reported as infesting sugar beet or as general “cropland” (e.g. specific crop unspecified)*

Weed	Herbicide Resistance	State & Year	Crops infested
Kochia	ALS-inhibitor resistant	ND 1987, MT 1989, MN 1994	Cropland & wheat
		MI 2005	Sugar beet
	Synthetic auxin	MT 1985	Cropland & wheat
Wild Oat	ACCase inhibitor	MT 1990 & 2002	Cropland, sugar beet, wheat
		MN 1991	Sugar beet & wheat
	Mitosis inhibitor	OR 1990	Cropland

***Summarized from preceding Table 16**

Based on data in the International Survey of Herbicide Resistant Weeds (Heap, 2010), since 2005, the year that H7-1 sugar beet was first commercially grown, there have been five confirmed cases of sugar beet weeds with herbicide resistance in sugar beet root production states. These include weeds with resistance to at least 3 modes of action:

- PSII inhibitors (redroot pigweed infesting potato in Idaho in 2005),
- ALS-inhibitors (kochia in Michigan infesting sugar beet in 2005 and giant foxtail in Michigan infesting corn and soybean in 2006), and
- Glyphosate (glycine mode of action), (Giant ragweed (*Ambrosia trifida*) and tall waterhemp (*Amaranthus tuberculatus*) infesting soybean in 2006 and 2007, respectively, both in Minnesota.

This is also consistent with world-wide trends in resistant weed biotypes since 2005, as there has been a relative leveling off of new weed biotypes with resistance to most herbicides, concurrent with an increase in the rate of new weed biotypes with resistance to glyphosate (Figure 3). In total 10 weed species in the US have been confirmed with resistance to glyphosate. Minnesota is the only sugar beet production state with confirmed cases of glyphosate resistant weeds that are major sugar beet weeds based on analysis of data collected by the International Survey of Herbicide Resistant Weeds (ISHRW) (Heap, 2010). However, although the ISHRW does not specifically report that these glyphosate resistant weeds occur in sugar beet, recent information indicates that they do occur in sugar beet fields near Hutchinson, MN and near Buxton, ND. In addition, in their recent weed control guide for sugar beet weed management, weed extension specialists Stachler and Zollinger (2009) indicate that glyphosate resistant giant ragweed, common ragweed and lambsquarter (unconfirmed) occur in Minnesota, and the latter two

resistant species also occur in North Dakota. Since the draft EA was published in October 2010, the status for some of the glyphosate resistant weeds in Minnesota and North Dakota was updated by the ISHRW on December 24, 2010, but they are still characterized as infesting soybean:

- Tall waterhemp in MN increased to upwards of 1000 sites and 100,000 acres.
- Giant ragweed in MN infests upwards of 1000 sites and 100,000 acres.
- Common ragweed in ND infests upwards of 50 sites, 1,000 acres and in MN infests up to 100 sites and 10,000 acres.

In summary, these data support the following conclusions:

- Herbicide resistant biotypes of weeds that are considered major weeds in sugar beet, are seldom reported as “infesting sugar beets”, but resistant sugar beet weed biotypes do occur in several major crops grown on much larger acreage, a portion of which are rotated with sugar beet in several sugar beet producing states.
- Since the introduction of glyphosate resistant sugar beet, few major sugar beet weeds have developed herbicide resistance, but glyphosate resistance has developed in at least two weed biotypes in soybeans in Minnesota, and these now occur in some sugar beet fields in Minnesota and North Dakota.

Table 1 in the Affected Environment section includes a summary of rotational crops that follow US sugar beet production and an estimation of the rotational crops as glyphosate-resistant (Roundup Ready) crops.

The major crops that follow sugar beet in rotation (from Table 1) and are confirmed to be infested with herbicide resistant biotypes of weeds that are also considered major weeds in sugar beet production states, and the maximum acreage estimated to be infested based on data from the International Survey of Herbicide Resistant Weeds (Heap, 2010), are listed below (Note: Sugar beet and other crops in parentheses were included in the original acreage estimate in the ISHRW but are not considered a major rotation crop for sugar beet).

ND – corn = 50 A, soybean = 1005 A, cropland, cereals & wheat = 2,021,500 A

MT – cereals = 50 A, barley = 100,000A, cropland & wheat & (sugar beet) =
1,020,000 A

ID – cereals & wheat = 210,000 A

MN – (corn) & soybean = 855 A, cropland & (sugar beet) & wheat = 20,000 A

MI – corn & soybean = 101,000 A, soybean = 1500 A

CO - corn = 20,000 A, barley & wheat = 500 A

WY - corn = 10,000 A

NE – corn (no acreage estimate available)

Thus the upper combined estimate of infested acres approaches 3.5 million. The lower estimate is roughly one-third this amount based on information in the ISHRW (Heap, 2010). By comparison, 1.4 million acres of sugar beet were planted in 2002 in these states (see EA Table 18).

Of the variety of crops that are included in rotations with sugar beet (see Table 18), those that include Roundup Ready crops are summarized in the Table 18 below. Minnesota has the highest acreage planted to sugar beet (table 18, column 2) and also the highest estimated acreage of Roundup Ready® rotational crop (soybean) planted in rotation with sugar beets (322,000 acres, which represents an estimated 64% of the total sugar beet crop planted in Minnesota) (Table 18, column 5). Rotational crops following sugar beets for which Roundup Ready® varieties are available were estimated to be mostly corn (ranging from 3-70%) and soybean (ranging from 25-70%). Lower estimates were given for alfalfa (5% in Idaho) and for sugar beets (10% in Wyoming). Nonetheless, the estimated acreage of Roundup Ready crop that is grown in rotation with sugar beet is estimated to be no more than 3.5% of the total acreage planted in that rotation crop (e.g. corn, soybean, alfalfa, or sugar beet) in those states (Table 18, last column).

Table 18. Rotational crops following US sugar beet production and an estimation of rotational crops as Roundup Ready® crops.

State	Total Sugar Beet Acres	Major Crops that Follow sugar beet in Rotation that have Roundup Ready® Varieties	Percent of Rotational Crop of Total Sugar Beet	Acreage of Roundup Ready® Rotational Crop Option and Percent of Total Sugar Beet Acres	Estimated Percent of Roundup Ready® Crops as Major Rotations
Minnesota	505,000	Soybean	70%	322,000 – 64%	3.42%
Colorado	44,000	Corn	70%	16,000 – 36%	1.10%
Idaho	212,000	Corn	3%	3,000 – 1.4%	0.40%
		Alfalfa	5%	6,000 – 2.8%	
Michigan	180,000	Soybean	25%	41,000 – 23%	2.23%
		Corn	65%	61,000 – 34%	
Montana	58,000	Corn	25%	7,000 – 12%	0.14%
North Dakota	265,000	Soybean	40%	96,000 – 36%	0.81%
		Corn	15%	21,000 – 7.9%	
Nebraska	57,000	Corn	50%	15,000 – 26%	0.15%
Wyoming	40,000	Corn	25%	5,000 – 12%	2.89%
		Sugar beets	10%	2,000 – 5.0%	

See Legend for Table 1 above.

Acreage planted of the specific crop is based on 2002 planting data (USDA-NASS. 2003).

Rotated crops and acreage following sugar beet production are based on communications from individual local experts. i.e., university agronomists, USDA-ARS and Monsanto field personnel.

Percent of Rotational Crop of Total Sugar Beet Column obtained by dividing Rotational Crop Acres Following Sugar beet by Total Sugar Beet Acres, Column 2, and multiplying by 100. (See Legend for Table 1 above).

Column 5, Acreage of Roundup Ready® Rotational Crop Option was derived from Table 1. In addition, Percentage of Total Sugar beet Acreage was derived by dividing the estimated RR rotational crop option acreage(table 18, column 5) by the sugar beet acreage planted for each state in Table 18, column 2.

Estimated Percentage of Roundup Ready ® Crops as Major Rotations obtained from Table 15 (last column), obtained by dividing the Acreage of Roundup Ready® Rotational Crop Option Total by the Total Acreage of Rotation Crop in the State Total (Column D Total of Table 15) and multiplying by 100.

The Affected Environment section describes the management practices that can be used to retard the development of herbicide resistance in general and for sugar beet in particular, including those available to conventional sugar beet growers and those who grow glyphosate resistant H7-1. Additive adverse cumulative impacts would be those that result from the inability of weed control methods to delay the development of herbicide resistant weed biotypes and/or control those that are already present in sugar beet such that the resistant weed populations affect rotation crops or other crops in the area to a level that is beyond what currently exists.

Because a glyphosate-based herbicide program is currently being used with H7-1 sugar beet, under the preferred alternative, glyphosate use for H7-1 is not expected to increase beyond current levels, as market penetration is already at 95%; therefore the current trend in selection of glyphosate resistant weeds in glyphosate resistant sugar beet is likely to continue. Thus far, as

demonstrated above, the current trend has been that glyphosate resistant weeds that have developed in other crops, e.g. soybeans, are beginning to appear in sugar beet fields. Current levels of glyphosate use in H7-1 sugar beets are a minor (approximately 0.8%) amount of total US glyphosate use (Table 6). In 2009, glyphosate use on sugar beet (1.8075 million lbs of acid equivalence) was roughly 1.3% of the total agricultural and fallow use of glyphosate in the US based on AgroTrak data (Gregory Watson and Keith Reding, Monsanto, personal communication, September 29 -30, 2010). Additionally, growers still would have the currently available weed control tools (e.g., non-glyphosate herbicides and cultural practices described in the Biological Environment Section of the Environmental Consequences Section) needed on a small scale to manage any glyphosate-resistant weeds, whether they are present in sugar beet or other crop production fields.

The Monsanto Technical Use Guide (Monsanto, 2010) makes general recommendations on management practices for weed resistance management for Roundup Ready® sugar beets, but it does not specifically make recommendations for Roundup Ready® sugar beets on how to control the major sugar beet weeds such as tall waterhemp and giant ragweed in Minnesota that have developed glyphosate resistance (alone and in combination with resistance to ALS-inhibitor herbicides and/or other herbicides). Stachler and Zollinger (2009) also report that giant ragweed with multiple resistances to glyphosate and ALS-inhibitor herbicides exist in Minnesota. Glyphosate resistant common ragweed has also been reported in North Dakota in 2008, and these biotypes continue to increase in both North Dakota (Stachler et al., 2009) and southern Minnesota (Stachler and Zollinger, 2009). Most of the APHIS analysis relied on confirmed reports of resistance. The recent internet report from NDSU from June 2010 indicates that there are also “reports from South Dakota and now in North Dakota of kochia escaping normal applications of glyphosate.” APHIS agrees that, if confirmed in these states, glyphosate resistant kochia could indeed be difficult to control in rotations with glyphosate resistant sugar beets and their rapid means of seed spread could lead to rapid expansion of the resistant populations with adverse consequences for nearby crops, particularly if biotypes are also resistant to all ALS inhibitors. The ISHRW Quik Stats last updated Feb 16, 2010 indicates that a biotype of kochia was reported as glyphosate resistant in 2007 and infests cotton, corn, and soybean in Kansas on up to 150 acres, but it was not reported in sugar beet growing states. In the NDSU report,

Zollinger notes that of the glyphosate resistant kochia populations in Kansas, “areas that practiced low use rates were the first to exhibit lack of control of kochia”.

Monsanto believes it is better to refer questions on what products to use to manage glyphosate resistant weeds in sugar beets to the local extension expert because recommendations are region-dependent (Keith Reding, Monsanto, personal communication September 30, 2010). North Dakota State University research conducted in 2009 by Fisher, Stachler, and Luecke has shown that clopyralid (Stinger, a synthetic auxin mode of action herbicide) mixed with glyphosate can provide effective post-emergent control of glyphosate resistant giant ragweed less than 6 inches tall. At two Minnesota locations, one NW of Hutchinson and the other SW of Hutchinson, 2-3 applications of the herbicide clopyralid (Stinger, a synthetic auxin mode of action herbicide) mixed with glyphosate provided excellent control of 1-3 inch glyphosate-resistant giant ragweed while preserving yield and extractable sucrose in glyphosate-resistant sugar beet. Similar results were obtained in North Dakota. Clopyralid without glyphosate was also tested. Increasing rates of clopyralid and frequency of applications were shown to improve common ragweed control, but increased sugar beet injury (Stachler et al., 2009). These preliminary results indicate that clopyralid used alone may be an effective option for control of glyphosate resistant ragweed that is 7.6 cm or smaller, although maximum control and yields were obtained when clopyralid was mixed with glyphosate. Sugar beet weed biotypes with confirmed resistance to synthetic auxin mode of action herbicides do not occur in Minnesota, however in North Dakota, kochia biotypes with this resistance were confirmed in 1995. Table 4 indicates that clopyralid is also rated as providing at least fair control of the following sugar beet weeds: nightshade, cocklebur, sowthistle, and Canada thistle. Ratings for lambsquarter ranged from poor to fair. However, it should also be noted that label recommendations for Clopyralid indicate that up to 18-month rotation restrictions apply to many crops due to risk of injury; and a field bioassay is recommended (Table 11). Clopyralid (Stinger) may have a herbicidally active residual in the soil. Wheat, barley, oats, grasses, corn, and sugar beets have good tolerance and can be planted any time after application. Other crops such as lentils, peas, safflower, potatoes, alfalfa, sunflowers, edible beans or soybean, can usually be planted 12 months after treatment, but extreme weather conditions can sometime cause the herbicide to persist longer (Cattanach et al., 1991). In addition to soybean, wheat and barley are already common rotation crops for sugar beet in Minnesota and North Dakota, and for N. Dakota, corn is also (see Table 1 above).

Specific recommendations for managing glyphosate-resistant weeds in glyphosate-resistant soybean are provided in the Monsanto TUG, and these do include recommendations for waterhemp (*Amaranthus* species) and giant ragweed.

For glyphosate resistant *Amaranthus* species the recommendations are:

“Preplant:

Apply a tank-mix of 22 oz I/A Roundup WeatherMAX with a pre emergence residual herbicide such as alochlor (INTRRO®), flumioxazin (Valor®) or another residual herbicide for preemergence control of Amaranthus species. 2,4-D may be added to the tank-mix to help control emerged Amaranthus species and other broad leaf weeds preplant only. Follow label instructions regarding application timing relative to soybean planting.

In-crop:

It is strongly encouraged that a preemergence residual product be used to control Amaranthus species prior to emergence.

If there is emerged Amaranthus in-crop, apply a tank-mixture of 22 oz/A Roundup WeatherMAX with a postemergence product with activity on Amaranthus such as lactofen (Cobra®), fomesafen (Flexstar®) or cloransulam (FirstRate). Applications should be made on emerged Amaranthus that does not exceed 3" in height. Read and follow all product label instructions.

It is likely that visual soybean injury will occur with these tank-mixtures.”

The only differences in the recommendations for Giant ragweed are for the preemergence control recommendations which recommend the use of a “preemergence residual herbicide such as cloransulam (FirstRate) or cloransulam + flumioxazin (Ganster®) or another residual herbicide for preemergence control of *Ambrosia* species.”

The TUG does not provide specific recommendations for biotypes of species with multiple herbicide resistance. Nonetheless, the herbicides specifically recommended for these two species are not of the class of herbicides (ALS-inhibitors and PI) for which multiple herbicide resistant biotypes have been reported with glyphosate, with the exception of cloransulam which

is an ALS-inhibitor herbicide. With respect to the herbicide mode of action, lactofen, fomesafen and flumioxazin are all protoporphyrinogen oxidase inhibitors. If recommended herbicides are not effective, hand weeding may be the best option for control before resistant populations become too large to manage cost-effectively with this method. Stachler and Zollinger (2009) also provide recommendations for managing herbicide resistant weeds in sugar beet in Minnesota and North Dakota based on the mode of action of the resistant herbicide.

As discussed in the Affected Environment – Biological Resources section, glyphosate use in GR sugar beet has proven to be an effective tool against weeds resistant to non-glyphosate herbicides, such as ALS-inhibitors and ACCase-inhibitors. The most widespread herbicide resistant weeds likely to impact sugar beet root production include kochia resistant to ALS-inhibitors and wild oat with resistance to ACCase inhibitors. This is based on the estimated large acreage of cropland infested with these resistant biotypes that includes sugar beets and/or its rotation crops as analyzed above. Of the herbicides commonly used in sugar beets, kochia is not controlled well with the typical preplant incorporated herbicide (Ro-Neet). In addition, these two species have biotypes that are resistant to many of the other herbicide modes of action used in sugar beets. Therefore the potential exists for multiple-herbicide resistant biotypes to emerge over time through crossing, and multiple herbicide resistant biotypes of both of these species have already been reported in North Dakota and/or Minnesota (Stachler and Zollinger, 2009; Stachler et al., 2009). However, because glyphosate generally has greater control ratings than other post-emergent herbicide options available to control ALS-inhibitor resistant kochia and ACCase inhibitor resistant wild oat biotypes (see Table 4), the preferred alternative will continue to allow growers of glyphosate resistant H7-1 derived varieties the option to control these resistant weed biotypes with post-emergent applications of glyphosate if they are present in sugar beet fields, and this in turn may reduce populations of these resistant biotypes in crops grown in rotation. These two biotypes are mostly a problem in wheat and cereals and one or both are known to infest these major rotation crops of sugar beet in ND, MT, ID, MN, and CO. Thus the post-emergent glyphosate control option in H7-1 sugar beet afforded by the preferred alternative has a small countervailing positive impact against the adverse effects of these existing herbicide resistant weeds.

Also, as indicated in the Environmental Consequences – Biological Environment Section, impacts, if any, with respect to the development of glyphosate-resistant weeds in sugar beet crops in the timeframe considered in this EA are expected to be very small, and that trend is expected to continue. First, sugar beets are a relatively small crop. H7-1 sugar beets account for less than one percent of the glyphosate-resistant crops grown in the US, and in those major sugar beet production states where glyphosate resistant crops (corn and soybean) are major rotation crops for sugar beet, H7-1 represents approximately 7% of the estimated total acreage planted to those glyphosate resistant rotation crops based on 2002 planting data from Table 1. This suggests that the likelihood for the development of new glyphosate-resistant weed populations in H7-1 when compared to other herbicide resistant crops in general or those that are grown in rotation with sugar beet (particularly corn and soybean) is smaller (Management practices in Roundup Ready alfalfa probably also result in a low chance of leading to glyphosate resistant weeds due to the small amount of glyphosate use in alfalfa.) This is borne out by analysis of the incidence of sugar beet weeds that have developed resistance to herbicides since the time that glyphosate resistant sugar beets were first grown commercially and the incidence of glyphosate resistant weeds in crops grown in rotation with sugar beet. The previous statement can also be justified on the following basis: 1) weed escapes in sugar beets are likely to be removed by hand hoeing prior to harvest which would reduce the chances for a glyphosate resistant weed to set seed; 2) sugar beets are rotated with crops where herbicides with other modes of action can be used for weed management across the rotation; and 3) it is as common for sugar beets to be rotated with small grains as it is to be rotated with Roundup Ready corn or soybeans. As discussed in the Environmental Consequences Section, the nature of glyphosate itself and the growing practices for sugar beets makes it less likely that new glyphosate-resistant weed populations will develop in sugar beets as a result of the use of glyphosate in sugar beets. Additionally, there is a high level of awareness about the potential for glyphosate resistant weeds and many readily available resources to assist growers with management strategies. Indeed, H7-1 growers are required to follow Monsanto's TUG, including its recommendations for adopting growing practices aimed at reducing the development of glyphosate-resistant weed populations. Finally, because herbicide resistance is a heritable trait, it takes multiple growing seasons for herbicide tolerant weeds to emerge and become the predominant biotype in a specific area (Cole, 2010). Researchers have concluded that even if growers completely relied on only one herbicide,

it is likely to take at least five years for a herbicide-resistant weed population to develop (Kniss, 2010; Beckie 2006; Neve, 2008; Werth, 2008). This is a reason why crop monitoring and follow up by University and industry weed scientist in cases of suspected resistance are important parts of all herbicide resistance stewardship programs. New research regarding the control of glyphosate resistant tall waterhemp and ragweed confirmed in sugar beet fields in parts of Minnesota and North Dakota indicate that an alternative post-emergent herbicide can provide control but the outcome is enhanced when combined with glyphosate. Thus the continued ability to use H7-1 along with post-emergent application of glyphosate will provide countervailing benefits to manage the adverse impacts of glyphosate resistant weeds as well as other herbicide resistant weeds in sugar beet, thereby reducing populations in subsequent crop rotations with other crops. Of all of the sugar beet growing states, Minnesota and North Dakota are estimated to have the largest acreages of soybean as a rotational crop following sugar beet, and 70 and 40% of the sugar beet acreage, respectively, is estimated to be rotated with soybean in these states (see Tables 1 and 18 above). To further reduce the possibility of glyphosate resistant weeds in subsequent crops and/or damage from some of the residual herbicides that may be needed to control them, growers can use alternative herbicides and/or alternative herbicide resistant crop systems, e.g. Liberty Link® soybeans, additional tillage or weeding, or alternative rotation crops (Gunsolus, 2008). The incremental impact with respect to herbicide resistant weeds in sugar beet root production areas with continued cultivation of H7-1 under the preferred alternative is not expected to result in significant cumulative adverse impacts when combined with the impacts from herbicide resistant weeds already present and any continued cultivation of other glyphosate resistant crops presently being grown in sugar beet production areas.

Other Biological Resources

Cumulative Impacts of Potential Increased Glyphosate Usage with the Cultivation of Glyphosate Tolerant Crops

Studies of the relationship between genetically engineered crops and herbicide use has shown that an increase in glyphosate tolerant crops can result in a decrease in mechanical tillage (Brimner et al., 2005; Fernandez-Cornejo, 2006; Gianessi and Reigner, 2006; Kleter et al., 2007; Sankula, 2006; Johnson et al., 2007). The potential cumulative impact from this reduction in mechanical tillage is discussed in the following sections along with differences in toxicological

profiles of glyphosate compared to other herbicides used in sugar beet production to arrive at potential cumulative impacts on other biological resources, and is also taken into consideration for the later sections on physical resources and human health and worker safety.

According to the USDA ERS (2009a), US farmers have adopted genetically engineered crops widely since their introduction in 1996. Soybeans and cotton genetically engineered with herbicide-tolerant traits have been the most widely and rapidly adopted GE crops in the US, followed by insect-resistant cotton and corn. Figure 6 shows the percentage of acres of genetically engineered crops in the US between 1996 and 2009.

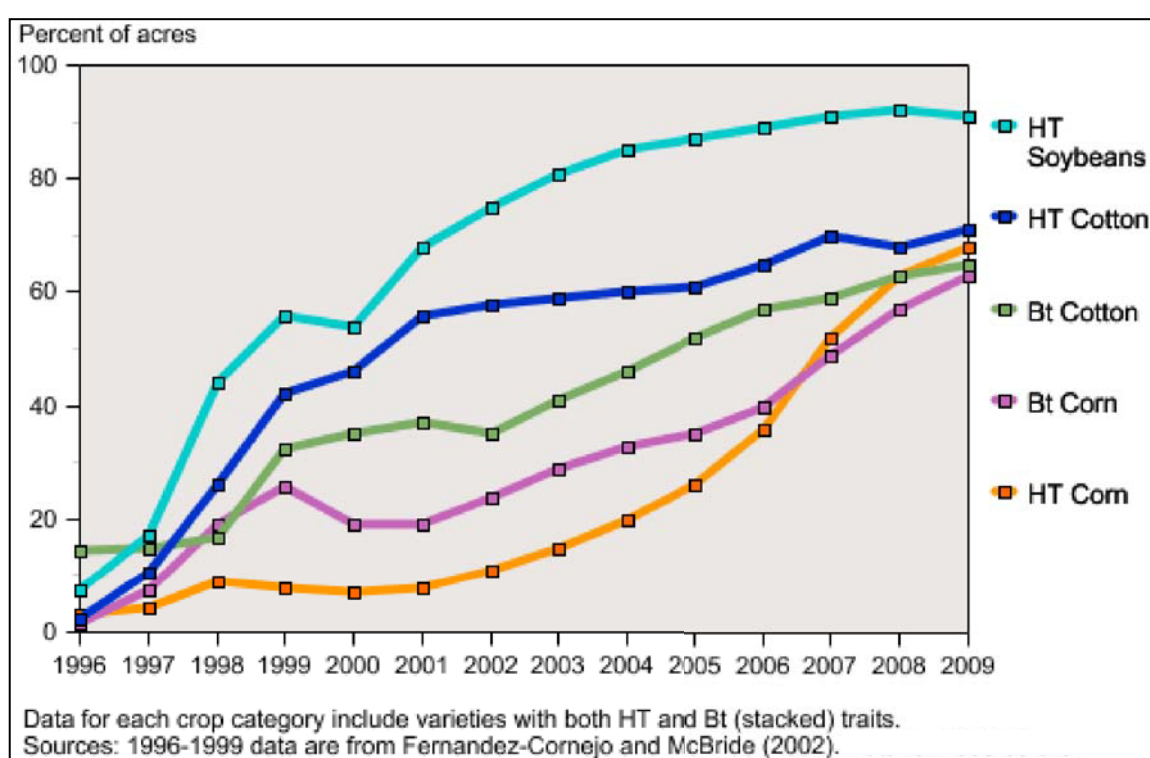


Figure 6. Growth in Adoption of Genetically Engineered Crops in US
Source: Graph from USDA ERS, 2009

Herbicide-tolerant crops, which are engineered to survive application of specific herbicides that previously would have damaged the crop, provide farmers with a broader variety of options for effective weed control. Based on USDA survey data, herbicide tolerant soybeans went from 17% of US soybean acreage in 1997, to 68% in 2001 and 91% in 2009. Plantings of herbicide tolerant cotton expanded from approximately 10% of US acreage in 1997 to 56% in 2001 and

71% in 2009. The adoption of herbicide tolerant corn, was slower in previous years, but has reached 68% of US corn acreage in 2009 (USDA ERS, 2009a).

Any cumulative impacts from continued glyphosate use as a result of the preferred alternative will be additive to the benefits already afforded by adoption of glyphosate resistant H7-1 derived varieties of sugar beet and other glyphosate resistant crops in those areas where sugar beet production overlaps that with other glyphosate tolerant crop production. Of the glyphosate resistant crops currently grown, cotton is not a major rotation crop for sugar beet. Furthermore, cotton is not grown in major sugar beet production states, with the exception of Arizona and California, where limited numbers of acres of sugar beet seedling production and small amount of sugar beet production occur, respectively (Furthermore, Alternatives 2, 3 and the Preferred Alternative would prevent the planting of H7-1 sugar beets in all of California for both root or seed production). However, corn and soybean can precede sugar beet in the rotation, and soybean, corn, and to a lesser extent alfalfa are considered major crops following sugar beets in rotation. The percent of total sugar beet estimated to be rotated with Roundup Ready® soybean, corn, and alfalfa for major sugar beet root production states based on 2002 sugar beet production acres is shown in Table 18 above.

Corn growers use the largest volume of herbicides. Approximately 96% of the 62.2 million acres used for growing corn in the 10 major corn-producing States were treated with more than 164 million pounds of herbicides in 1997 (USDA ERS, 2009a). Soybean production in the US also uses a large amount of herbicides. Approximately 97% of the 66.2 million soybean acres in the 19 major soybean producing States were treated with more than 78 million pounds of herbicides in 1997 (USDA ERS, 2009a). Cotton production relies heavily on herbicides to control weeds, often requiring applications of two or more herbicides at planting and postemergence herbicides later in the season (Culpepper and York, 1998). Close to 28 million pounds of herbicides were applied to 97% of the 13 million acres devoted to upland cotton production in the 12 major cotton-producing States in 1997 (USDA ERS, 2009a).

Pesticide use on corn and soybeans has declined since the introduction of GE corn and soybeans in 1996. Several studies have analyzed the agronomic, environmental, and economic effects of adopting GE crops, including actual pesticide use changes associated with growing GE crops (McBride and Brooks, 2000; Fernandez-Cornejo et al., 1999; Fernandez-Cornejo et al., 2002;

Giannessi and Carpenter, 1999; Culpepper and York, 1998; Marra et al., 1998; Falck-Zepeda and Traxler, 1998; Fernandez-Cornejo and Klotz-Ingram, 1998; Gibson et al., 1997; ReJesus et al., 1997; Stark, 1997). Many of these studies have concluded that herbicide use is reduced with herbicide-tolerant varieties (USDA ERS, 2009a). In contrast, Benbrook et al 2009, report “that GE crops have been responsible for an increase of 383 million pounds of herbicide use in the US over the first 13 years of commercial use of GE crops (1996-2008).”

Studies conducted by the USDA however, also show an overall reduction in pesticide use related to the increased adoption of GE crops. Based on the adoption of GE crops between 1997 and 1998 (except for herbicide-tolerant corn, which is modeled for 1996-97), the decline in pesticide use was estimated to be 19.1 million acre-treatments, 6.2% of total treatments (USDA ERS, 2009a). Most of the decline in pesticide acre treatments was from less herbicide used on soybeans, accounting for more than 80% of the reduction (16 million acre-treatments) (USDA ERS, 2009a). Sugar beet is estimated to be rotated to soybean more than 35% of the time, more than any other major rotation crops (Table 1), and 91% of the US soybean crop is estimated to be glyphosate tolerant. The adoption of herbicide-tolerant crops such as H7-1 sugar beets, glyphosate-tolerant soybeans and glyphosate-tolerant corn will result in the substitution of glyphosate for some of the previously used herbicides. As discussed in the Environmental Consequences section (and see Table 1), only in southern Minnesota and Michigan are farmers likely to include glyphosate resistant crops in a large majority of the rotations. Even so, as described earlier in the Affected Environment Biological Resources section, the glyphosate used on H7-1 derived sugar-beet varieties accounts for less than 1% of the US total. The glyphosate tolerant crops allow farmers to limit and simplify herbicide treatments based around use of glyphosate, while a conventional weed control program can involve multiple applications of several herbicides. In addition, and more importantly, herbicide-tolerant crops often allow farmers to use more benign herbicides (USDA ERS, 2009a) unless resistance develops.

There are known benefits associated with the use of glyphosate herbicides compared to herbicides currently used by sugar beet producers. Glyphosate has documented favorable characteristics with regard to risk to human health, non-target species, and the environment (Malik et al., 1989; Geisy et al., 2000; Williams et al., 2000).

For non-target terrestrial species, available ecological assessments in EPA RED (US EPA, 1993) documents or registration review summary documents provide the support that the use of glyphosate represents reductions in chronic risk to birds compared to trifluralin and sethoxydim, in acute risk to small mammals in comparison to EPTC, in chronic risk to mammals from quizalofop-p-ethyl, in acute risk to endangered birds and mammals from pyrazon, and in chronic risk to mammals and potentially birds from cycloate. For all other sugar beet herbicide products, as well as glyphosate, no significant risks to birds or other non-target terrestrial species were indicated in the available information.

For non-target aquatic species, Tables 12, 13, and 14 provide summaries of the estimated exposure and hazard information for the traditional herbicides used in conventional sugar beet production, and present quantitative comparisons of the derived Risk Quotients. Exposure, defined as the EEC, was calculated for all products using the standard assumptions (assuming aerial application) of 5% drift of spray applied to a one-acre field onto water and 5% runoff from 10 treated acres into a one-acre pond six feet in depth. Herbicide treatments were based on the maximum single application rate taken from product labels. Hazard information (LC50 or EC50) for each active ingredient was taken from the EPA OPP Pesticide Ecotoxicity Database (if available) or other EPA source documents and summarized in Tables 12, 13, and 14 as the upper and lower values from the range of values reported. Hazard information for the end-use formulated products is generally not readily available, thus this analysis is a comparison based solely on the active ingredients. Any label warnings and other available hazard and/or risk descriptions for non-target aquatic species are also included. The Risk Quotient is determined for each active ingredient by dividing the EEC by the hazard (LC50 or EC50) value.

Plants potentially at risk from the use of glyphosate are potentially at risk from the use of any herbicide to which they are sensitive. Like many broad-spectrum herbicides, plants are highly sensitive to glyphosate. Monsanto has developed a program named Pre-Serve to address aerial spraying in areas where threatened or endangered plants may be located. Following label use instructions and use limitations described in Pre-Serve would address any such risk of exposure. Federal law requires pesticides to be used in accordance with the label. Because glyphosate binds strongly to soil particles, conservation tillage and no tillage practices provide additional assurance that the impacts to aquatic plants are negligible.

The labels for products containing desmedipham, phenmedipham, sethoxydim, clethodim, pyrazon, quizalofop-p-ethyl, and trifluralin include warnings of toxicity or adverse effects to fish, and/or aquatic invertebrates and/or aquatic plants. Risk Quotients that exceed the Trigger Value of 0.5 for aquatic animals and 1.0 for aquatic plants are highlighted in bold text in Tables 10, 11, and 12 as exceeding a Level of Concern, based on EPA Ecological Effects Rejection Analysis and Deterministic Risk Characterization Approach. Current sugar beet herbicide products containing trifluralin and pyrazon are shown to exceed these Levels of Concern. As supported by the EPA designation of reduced risk for application of glyphosate to H7-1 sugar beet, glyphosate is a more environmentally preferred herbicide compared to other herbicides currently used in sugar beet production since glyphosate is generally less toxic and has favorable degradation properties. No significant impacts on microorganisms from changes in herbicide use patterns for roots, seeds or steckling production were identified in the previous Environmental Consequences sections.

The preferred alternative would allow for the continued use and application of glyphosate-based herbicide formulations as post-emergent applications in H7-1 derived sugar beet varieties, in addition to pre-emergent applications. This could result in continued glyphosate exposure to animal and plant species within and adjacent to those fields through drift as discussed previously, and a decrease in exposure to other herbicides from runoff and/or drift (USDA APHIS, 2009).

Based on the data available on glyphosate usage, chemical fate, and toxicity, glyphosate is not expected to pose an acute or chronic risk to the following categories of wildlife: (US EPA, 1993)

- birds
- mammals
- terrestrial or aquatic invertebrates
- fish
- microorganisms

Glyphosate is practically nontoxic to slightly toxic to birds, freshwater fish, marine and estuarine species, aquatic invertebrates and mammals and practically nontoxic to honey bees (which are used to assess effects on nontarget insects in general); (EPA 1993). Glyphosate is not expected to accumulate in fish or other animal tissues. Glyphosate products containing surfactants with

toxicity to aquatic organisms are required to carry restrictions regarding application near water (US EPA, 1993). Under the preferred alternative, impacts on animals especially could continue to be reduced by the continued use of glyphosate on sugar beet root production because of reduced exposure to other more toxic herbicides from runoff and/or drift (USDA APHIS, 2009). When used according to Pre-serve methods, glyphosate drift to non-target plants should not pose a hazard. Positive impacts, relative to those used in conventional sugar beet production, are expected to produce greater cumulative impacts when combined with benefits expected from herbicide use in rotation crops and surrounding crops in those areas where glyphosate resistant cropping systems are more prevalent and are included in rotation with glyphosate resistant sugar beet. These areas include sugar beet root production areas in Minnesota, North Dakota, Nebraska, Michigan, and Colorado (see Tables 1 and 18 above). In addition, the risk to nearby nontarget crop plants through accidental drift will be reduced if the nearby crop is also glyphosate resistant. If growers adopt low- or no-till farming practices, which is common with users of this technology, negative impacts associated with water/fertilizer/pesticide run off from fields would also continue to be reduced. Nonetheless, given the diversity in crop rotation options and the crop rotation cycle for sugar beet production in most states and the relatively small acreage of sugar-beet production and associated glyphosate use compared to other glyphosate-resistant crops and overall glyphosate use, the cumulative impacts are not expected to be significant.

Socioeconomic Environment

Sugar Beet Production in the US and Its Contribution to the Sugar Market

As summarized in the Environmental Consequences Section on Socioeconomic Impacts, the preferred alternative would permit H7-1 seed to be planted for root and seed production for the 2012 root crop under appropriate regulatory authorization. This would allow breeding programs and variety trials to continue to inform future planting decisions and fulfill grower contracts for planting. This will result in less disruption to the sugar industry compared to the no action alternative and allow for long term stability of the US sugar market. This will result in the maintenance of the supply of improved and approved sugar beet varieties to breeders and growers; maintenance of sugar beet yields and income to growers, contractors and sugar beet processors; continued availability of sugar from sugar beets to consumers and food processors;

and price stability to consumers. There would be no or negligible impact on sugar companies and cooperatives. No cumulative impact is expected.

Non-GE Sugar Beet Seed Availability and Impacts on Consumers Choosing Non-GE Sugar

As summarized in Environmental Consequences Section on Socioeconomic Impacts, conventional sugar beet seed is in short supply. However, there has been little demand for conventional (non-GE) sugar beet varieties, and due to the adoption of varieties with the H7-1 trait, nearly all new official entries for trials for approved varieties have the H7-1 trait. Seed production decisions are based on the forecasted demand in future years, and H7-1 varieties are what the large majority of sugar beet farmers have been choosing to purchase. Under the preferred alternative, seed providers would continue to initiate seed production of H7-1 varieties, and would only initiate seed production of conventional varieties where there is a clear market demand. This alternative would therefore continue the trend toward lower reserves and availability of conventional seed in future years; however this is not expected to result in a significant impact unless there is later an increase in the demand for these conventional seeds. Since none of the US sugar beet processing facilities process organic sugar beets, there is unlikely to be an increase in demand of conventional sugar beet seeds. Furthermore, no impact is expected on the ability of consumers and industrial food producers to continue to use other sources of sweeteners that are not derived from GE organisms (such as cane sugar, honey, maple syrup, and stevia) if they have preferences that do not include products of biotechnology.

Vegetable Beet Seed and Root Production

As summarized in Environmental Consequences Section on Socioeconomic Impacts, the preferred alternative is expected to have no or negligible impacts to vegetable beet seed production and vegetable beet root production, regardless of whether the vegetable beet or seed is intended to be certified as organic through the National Organic Program. Any impacts that could arise through: (1) gene flow from H7-1 sugar beet seed fields, volunteers, or bolters to vegetable beet seed fields or bolters; or (2) mixing of H7-1 sugar beet seed or beets with vegetable beet seed or beets are expected to be reduced to no or negligible impacts through the permit conditions proposed by APHIS. Furthermore, if breeder seed did have a low level presence of H7-1, steps can be taken to clean up the seed (see Environmental Consequences

section). From the above analysis, it can be concluded that there should be no significant cumulative impacts on co-existence of growers who choose to grow conventional or organic crops and those who choose to grow H7-1 derived sugar beet varieties.

Physical Resources

Land Use

As discussed in Environmental Consequences Section on Physical Resources, sugar beet acreage has fluctuated little for the past 50 years, was not impacted by the introduction of H7-1, and is not expected to be impacted by continued use of H7-1 as proposed under the preferred alternative. Therefore, as discussed in the Environmental Consequences Section, the preferred alternative is not expected to impact land use, and therefore there will be no cumulative impacts on land use.

Air Quality and Climate

As discussed in the Environmental Consequences Section on Physical Resources, the preferred alternative is expected to continue to have small positive impacts on air quality and climate, primarily resulting from reduced tillage. Emissions related to global warming, ozone depletion, summer smog and carcinogenicity, among others, were found to be lower in glyphosate-tolerant crop systems than conventional systems (Bennett et al., 2004). In a study of conventional compared to Roundup tolerant sugar beets in Idaho, the Roundup® tolerant sugar beets required fewer cultivations, fewer herbicide applications, and on average 1.7 fold less fuel to make these passes through the crop, and consequently, it was estimated that among the four cultivation and herbicide treatment regimes, fuel reductions ranging from 0.6-2.5 gallons/acre resulted in 5.8 to 24.1 fewer pounds of carbon released per acre (as CO₂) in H7-1 production than in conventional sugar beet production (Hirnyck and Morishita, 2007). This impact will be less for H7-1 seed production due to the limited use of glyphosate as a post-emergent herbicide in hybrid seed production fields compared to H7-1 sugar beet root production and also in terms of lower acreage planted to seed and stecklings. The positive impact is only expected to provide incremental impacts that will be cumulative in those areas where rotation crops also implement conservation tillage practices. One such situation would be in those areas where other Roundup

Ready® crops follow sugar beet in rotation (see Table 18 above). Because of the crop rotation practices and crop rotation cycles for sugar beet, and the relatively small number of acres planted to sugar beet relative to other crops, none of the cumulative impacts are expected to be significant.

Water Quality and Availability

As discussed in the Environmental Consequences Section on Physical Resources, the advent of glyphosate tolerant crops and the use of post-emergent herbicides that could be applied over a crop during the growing season have facilitated the use of conservation tillage farming practices, since weeds could be controlled after crop growth without tilling the soil (USDA ERS, 2009a). The use of glyphosate tolerant crops (particularly soybeans) has intensified that trend since it often allows a more effective and less costly weed control regime than using other post-emergent herbicides (USDA ERS, 2009a; Carpenter and Gianessi, 1999).

The impact of conservation tillage (including no-till, ridge-till, and mulch-till) in controlling soil erosion and soil degradation is well documented (Edwards, 1995; Sandretto, 1997). By leaving substantial amounts of plant matter over the soil surface, conservation tillage 1) reduces soil erosion by wind; 2) reduces soil erosion by water; 3) increases water infiltration and moisture retention; 4) reduces surface sediment and water runoff; and 5) reduces chemical runoff (USDA ERS, 2009a). However, conservation tillage systems and glyphosate based weed management can also affect weed population dynamics and results have been mixed. In a detailed review, Moyer et al. (1994) provided a list of weeds that are reportedly favored by conservation or conventional tillage systems.

Glyphosate may potentially be found in surface water runoff when erosion conditions lead to the loss of surface particles. However, as discussed in the Environmental Consequences Section on Physical Resources, the preferred alternative is expected to lead to an increase in conservation tillage and no tillage systems, which would result in less mechanical disturbance of the soil during sugar beet cultivation and thereby decrease the loss of surface soil. Because of this, and the fact that glyphosate binds strongly to soil particles, no-tillage and conservation tillage are expected to further reduce the likelihood of any impact from surface water runoff (Wiebe and

Gollehon, 2006). Therefore, no cumulative adverse impacts to surface water or groundwater are anticipated.

In addition, as discussed in Environmental Consequences section on Physical Resources, glyphosate has a lower risk potential with respect to surface and ground water contamination compared to many of the other alternative herbicides used in sugar beet (Hirnyck and Morishita 2007), and it has reduced risk potential to aquatic organisms and humans (see Tables 10-14 above and the Human Health section below).

Since the cumulative impacts on water quality are related to both tillage and relative toxicity (particularly with respect to humans and aquatic organisms) of herbicides likely to be used in conventional sugar beets compared to glyphosate resistant sugar beets, the cumulative impact summary for biological organisms and human health are also applicable. Because of the crop rotation practices and crop rotation cycles for sugar beet, and the relatively small number of acres planted to sugar beet relative to other crops, none of the cumulative impacts are expected to be significant.

Human Health and Safety

A tolerance increase was required to support approval for the use of glyphosate in the H7-1 sugar beet-cropping system compared to the limited pre-emergent use of glyphosate in conventional sugar beet production. However, the potential health effects of pesticide residues that may be present in food, regardless of whether they result from uses in conventional or glyphosate tolerant crops, are carefully considered by EPA before establishing maximum residue limits or tolerances. Regardless of whether Alternative 1, 2, 3 or the Preferred Alternative is chosen for sugar beet root production, it will not change the tolerance level set by EPA for glyphosate in sugar beet or other crops, but Alternative 1 is expected to result in a return to glyphosate use levels in conventional sugar beets similar to those before 2005 when H7-1 was originally deregulated.

Before establishing a tolerance in an agricultural commodity, EPA must find that the potential resulting residues covered by the proposed tolerance will be “safe”. Section 408(b)(2)(A)(ii) of the FFDCA [21 USC 346a(b)(2)(A)(i)] defines “safe” as a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue. As part of this determination,

the total maximum theoretical level of residue present in all food commodities with approved uses for the pesticide must not exceed the EPA established Reference Dose (RfD), or chronic Population Adjusted Dose (cPAD). Following a comprehensive review of the results of toxicological studies conducted on the pesticide, the RfD is set by applying appropriate uncertainty factors to the most appropriate No-Observed-Adverse-Effect-Level (NOAEL).

In 1999, EPA conducted a dietary exposure risk assessment and concluded that the incremental dietary exposure associated with the use of glyphosate on glyphosate tolerant sugar beet did not pose a concern to human health (64 FR 18360, 1999).

In a recent risk assessment supporting establishment of certain new food crop tolerances for glyphosate, EPA estimated that chronic (daily dietary) exposure to glyphosate from all food and water sources would use only 2% of the glyphosate RfD (1.75 mg/kg/day) for the general US population and 7% of the RfD for the highest potentially exposed subgroup population (71 FR 76180, 2006).

The cumulative impacts to pesticide applicators from use of glyphosate on sugar beets were considered. Biomonitoring of pesticide applicators conducted by independent investigators has shown that bodily adsorption of glyphosate as the result of routine, labeled applications of registered glyphosate-based agricultural herbicides to crops, including to glyphosate tolerant sugar beet, was thousands of times less than the allowable daily intake level established for glyphosate (Acquavella et al., 2004). Given similarity to current use pattern, herbicide label rates, and the percentage of cultivated acres for sugar beets, the continued use of H7-1 sugar beet as under the preferred alternative will not significantly increase the exposure risk to pesticide applicators. Furthermore, EPA, the European Commission, the WHO, and independent scientists have concluded that glyphosate is not mutagenic or carcinogenic, not a teratogen nor a reproductive toxicant, and that there is no evidence of neurotoxicity associated with glyphosate (US EPA, 1993; EC, 2002; WHO, 2005; Williams et al., 2000).

Bystander exposure to glyphosate as a result of pesticide application to H7-1 sugar beet would be negligible, since such applications would occur in an agricultural setting in relatively rural sugar beet fields, not in an urban setting.

Presented below is a brief, comparative analysis of the hazard/risk characteristics of glyphosate, the active ingredient in Roundup WeatherMAX® herbicide (EPA Registration No. 524-537), to the most commonly used herbicides applied in conventional sugar beet production, based on total pounds of active ingredient applied (USDA NASS, 2001c). A detailed assessment of the potential chronic human health risks compared to traditional products will not be presented in this comparison; it is sufficient to state that the chronic RfD values for each active ingredient is lower (less safe) than that of glyphosate. Acute RfDs where available in their respective RED (cycloate, EPTC, ethofumesate, sethoxydim and trifluralin) reflect greater acute toxicity than glyphosate. The assessment is based on information obtained from various sources, including product-specific labeling (for comparing all acute toxicities), EPA Reregistration Eligibility Documents, EPA RED Fact Sheets (for all comparator active ingredients), product-specific *Federal Register* publications (Clethodim Human Health Risk Assessment for Proposed Use on Field Corn, EPA-HQ-OPP-2008-0658-0004; Clopyralid Tox, *Federal Register* Vol. 62, No. 48 p. 11362), the EPA Ecotoxicology One-Liner database (now called the EPA OPP Pesticide Ecotoxicity Database), the USDA Pesticide Properties database¹¹, and other public sources of product-specific toxicological and environmental profile information. The assessment shows that in the majority of cases, weed control with glyphosate formulated and sold as Roundup WeatherMAX herbicide in the H7-1 sugar beet system offers the benefit of less risk from potential exposure for applicators and handlers of concentrated product and a reduced potential to impact non-target species and water quality.

Table 11 provides a comparison of product-specific labeling for herbicides commonly used for weed control in sugar beet production, including required precautionary statements associated with acute exposure hazards and environmental risk concerns. Although most alternative products carry the same signal word as Roundup WeatherMAX herbicide (CAUTION), the associated precautionary statements of each of the alternative herbicide products are indicative of toxicity findings that represent a greater acute exposure risk than Roundup WeatherMAX.

[®] Roundup UltraMAX is a registered trademark of Monsanto Technology LLC

Nearly every sugar beet herbicide product evaluated has more restrictive requirements for the use of Personal Protective Equipment (PPE) than those required for Roundup WeatherMAX herbicide, indicating a greater need to reduce the risk of acute exposure, and, in some cases, the risk of longer-term or chronic exposure, for applicators and handlers of these other products.

The comparative analyses provided in this section are summarized in Table 19 and show those areas for which glyphosate (designated with a checkmark ✓), using Roundup WeatherMAX herbicide in the comparison, offers the benefit of potential risk reduction compared to the most commonly used sugar beet herbicides in sugar beet production. In this cumulative comparison, glyphosate offers potential benefits over all the traditional sugar beet herbicides in at least one and up to six risk assessment categories. These comparisons demonstrate the benefits to not only applicators and mixers, but also to non-target organisms from the use of glyphosate in the H7-1 sugar beet system.

Table 19. Potential Reduction in Risk from Use of Glyphosate Compared to Traditional Herbicides Used in US Sugar Beet Production

Active Ingredients ¹	Human Health Risk		Non-Target Species Risks				Groundwater Contamination	Total Number of Areas for Potential Risk Reduction
	Acute	Chronic	Mammals	Fish	Aquatic Invertebrates	Aquatic Plants	Avian	
Clethodim	✓	✓					✓	3
Clopyralid	✓						✓	2
Cycloate	✓		✓				✓	4
Desmedipham	✓	✓					✓	3
EPTC	✓	✓	✓				✓	4
Ethofumesate	✓			✓			✓	3
Phenmedipham	✓							1
Pyrazon	✓		✓			✓	✓	5
Quizalofop-p-ethyl	✓		✓				✓	3
Sethoxydim	✓	✓					✓	3
Trifluralin	✓	✓		✓	✓	✓		6
Triflufurfuron	✓							1

¹ Traditional herbicides are compared to glyphosate, using the label from Roundup WeatherMAX herbicide.

✓ Indicates there is a potential for reduction in risk category by using Roundup agricultural herbicides.

Summary of Potential Cumulative Impacts to Biological Organisms from Increased Use of Glyphosate

When considering the impact that the use of glyphosate in the H7-1 sugar beet system could have on the human environment in conjunction with the use of glyphosate in other glyphosate tolerant crops already being cultivated in the same affected environments, the facts suggest that this use will have little or no additive effect. Alternatively, this has the potential to reduce risks to the affected environment from the use of other, more harmful, herbicides. This is supported by the assessment of the environmental and worker safety hazards associated with glyphosate when compared to other available herbicides used for weed control in sugar beet production. Based on such an assessment, EPA granted reduced risk status for this use of glyphosate, and expedited the review of supporting residue data. Therefore, there is no reasonably anticipated adverse cumulative impact on human health or the environment from the use of glyphosate associated specifically with the continued cultivation of H7-1 sugar beets as proposed with or without conditions proposed under Alternative 2, 3 or the Preferred Alternative.

I. Compliance with Statutes, Executive Orders and Regulations

Executive Order (EO) 12898 (US NARA, 2010), “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefiting from such programs. It also enforces existing statutes to prevent minority or low-income communities from being subjected to disproportionately high and adverse human health or environmental effects.

EO 13045 (US NARA, 2010), “Protection of Children from Environmental Health Risks and Safety Risks,” acknowledges that children may suffer disproportionately from environmental health and safety risks because of their developmental stage, greater metabolic activity levels, and behavior patterns, as compared to adults. The EO (to the extent permitted by law and consistent with the agency’s mission) required each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children.